



CDG-100US

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appln. No: 09/801,507  
Applicant: Aaron a. Rosenblatt et al.  
Filed: March 8, 2001  
Title: METHODS OF TREATING WATER USING COMBINATIONS OF  
CHLORINE DIOXIDE, CHLORINE AND AMMONIA  
TC/A.U.: 1724  
Examiner: Peter A. Hruskoci  
Confirmation No.: 5293  
Notice of Appeal Filed: June 13, 2003  
Docket No.: CDG-100US

RECEIVED  
SEP 23 2003  
TTC 1100

APPEAL BRIEF UNDER 37 C.F.R. § 1.192

Mail Stop Appeal Brief-Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

S I R:

The Applicants (now Appellants), appeal from the Final Rejection dated March 13, 2003, which finally rejected claims 4-38 of the subject application. It should be noted that in the Final Rejection, there was no summary of the claims indicating that claims 4-38 were finally rejected and claims 1-3 were withdrawn from further consideration. A Notice of Appeal was filed under a Certificate of Mailing dated June 13, 2003, and acknowledged as being received on June 17, 2003, by the United States Patent and Trademark Office.

**I. REAL PARTY IN INTEREST**

The real Party In Interest is the Assignee CDG Technology Inc. of Bethlehem, Pennsylvania, 18018.

09/18/2003 AWONDAF1 00000008 09801507

01 FC:2402

160.00 OP

## **II. RELATED APPEALS AND INTERFERENCES**

There are no related appeals or interferences known to Appellants or the Appellants' legal representative, which would directly affect, be directly affected by or have a bearing on the Honorable Board's Decision in this Appeal.

## **III. STATUS OF CLAIMS**

Claims 4, 12, 13, 15, 18, 22, 26, 28, 32, 34 and 37 are independent claims. Claims 5-11 depend on claim 4, claim 14 depends on claim 13, claims 16-17 depend on claim 15, claims 19-21 depend on claim 18, claims 23-24 depend on claim 22, claim 27 depends on claim 26, claims 29-31 depend on claim 28, claim 33 depends on claim 32, claims 35-36 depend on claim 34 and claim 38 depends on claim 37. Appellants respectfully submit that the independent claims 4, 12, 13, 15, 18, 22, 26, 28, 32, 34 and 37 are patentable and, rely, for support of this contention on the arguments presented herein below. In view of the fact that claims 4, 12, 13, 15, 18, 22, 26, 28, 32, 34 and 37 are patentable claims dependent thereon would also be patentable. In summary, Appellants are appealing the Examiner's decision of finally rejecting claims 4-38.

## **IV. STATUS OF AMENDMENTS**

The above-identified application was filed on March 8, 2001. The original application contained 38 claims.

In a first Office Action dated September 19, 2002, the Examiner issued a Restriction Requirement under 35 U.S.C. § 121, claiming that claims 1-3 (identified as Group I) were one invention and claims 4-38 (identified as Group II) were a second invention. Appellants' attorney made a provisional election on September 17, 2002 during a telephone conversation with the Examiner, to prosecute the invention of Group II, i.e. claims 4-38. The Examiner rejected claim 12 under 35 U.S.C. § 103(a) over Griesse et al. U.S. Patent 5,314,629 in view of Hurst U.S. Patent 4,693,832. The Examiner rejected claims 22-28 and 30 under 35 U.S.C. § 103(a) over Griesse et al. in view of Harp et al. U.S. Patent 6,315,950. The Examiner rejected claims 4-11, 18-21, 29 and 31 under 35 U.S.C. § 103(a) over Griesse et al.

in view of Hurst and further in view of Harp et al. The Examiner rejected claims 13 and 15 under 35 U.S.C. § 103(a) over Griesse et al. in view of Glew et al. U.S. Patent 4,137,296. The Examiner rejected claims 14, 16 and 17 under 35 U.S.C. § 103(a) over Griesse et al. in view of Glew et al. and further in view of Harp et al. The Examiner rejected claims 32, 34 and 37 under 35 U.S.C. § 103(a) over Griesse et al. in view of Glew et al. and further in view of Rosenblatt et al. U.S. Patent 5,110,580. The Examiner rejected claims 33, 35, 36 and 38 under 35 U.S.C. § 103(a) over Griesse et al. in view of Glew et al. and Rosenblatt et al. and further in view of Harp et al.

Appellants filed an Amendment and a Request for Extension of Time under Certificate of Mailing dated 16 January 2003. Appellants cancelled claims 1-3 and argued the impropriety of the rejection of claims 4-38.

The Examiner issued a final Rejection on March 13, 2003. The Examiner again rejected claim 12 under 35 U.S.C. § 103(a) over Griesse et al. in view of Hurst. The Examiner again rejected claims 22-28 and 30 under 35 U.S.C. § 103(a) over Griesse et al. in view of Harp et al. The Examiner again rejected claims 4-11, 18-21, 29 and 31 under 35 U.S.C. § 103(a) over Griesse et al. in view of Hurst and further in view of Harp et al. The Examiner once again rejected claims 13 and 15 under 35 U.S.C. § 103(a) over Griesse et al. in view of Glew et al. The Examiner once again rejected claims 14, 16 and 17 under 35 U.S.C. § 103(a) over Griesse et al. in view of Glew et al. and further in view of Harp et al. The Examiner again rejected claims 32, 34 and 37 under 35 U.S.C. § 103(a) over Griesse et al. in view of Glew et al. and further in view of Rosenblatt et al. The Examiner again rejected claims 33, 35, 36 and 38 under 35 U.S.C. § 103(a) over Griesse et al. in view of Glew et al. and Rosenblatt et al. further in view of Harp et al.

Appellants reviewed the Final Rejection and believing that the Examiner did not fully appreciate nor respond to the lengthy amendment filed in response to the first Office Action came to the conclusion that an amendment after final would be of no benefit to Appellants. In view of this conclusion Appellants filed a Notice of Appeal under Certificate of Mailing dated June 13, 2003.

## **V. SUMMARY OF INVENTION**

In a first aspect the present invention relates to a method for treating water as it proceeds from a source to a storage or distribution facility by injecting a mixture of chlorine and chlorine dioxide into the water at a location between the source and the storage or distribution facility, and injecting ammonia into the water either upstream or downstream of the location where the chlorine and chlorine dioxide are injected into the water, the ammonia being injected in an amount to substantially react with the chlorine, whereby the water in the storage or distribution facility contains chlorine dioxide, monochloramine and a negligible amount of chlorine.

In a second aspect the present invention is a method for treating water wherein a stream containing chlorine and chlorine dioxide is used to treat drinking water, wherein the mixed chlorine/chlorine dioxide stream (either as a gas or in solution) is injected into the water being treated and where the point of injection is after THM precursors are removed from the water, such that the level of chlorinated bi-products created is within acceptable limits.

In a third aspect the present invention is a method for treating water by providing a stream containing chlorine/chlorine dioxide, separating the mixed chlorine/chlorine dioxide stream into two streams, the first of which contains chlorine dioxide that is substantially chlorine-free, and the second stream contains chlorine with a lower level of chlorine dioxide than in the original stream, injecting the stream of chlorine into the water being treated at a point in the process after removal of sufficient organic material such that the level of chlorinated organic created is at or below an acceptable level, and using the chlorine dioxide stream to oxidize contaminants and disinfect drinking water at a point in the process before sufficient organics have been removed to allow treatment with a stream containing substantial amounts of chlorine.

A fourth aspect of the present invention is a method for treating water using a stream containing chlorine and chlorine dioxide to treat drinking water, by separating the chlorine from the chlorine dioxide to yield a stream of chlorine and a stream of chlorine dioxide, using the stream of chlorine dioxide to pre-oxidize the

stream of raw water prior to subsequent processing steps, and using the stream of chlorine to disinfect the water after some solids have been removed from the water but prior to storage or for distribution.

In a fifth aspect the present invention is a method for treating and disinfecting raw or partially treated water by introducing a mixture of chlorine, chlorine dioxide and ammonia into the raw or partially treated water to provide disinfection of the water by chlorine dioxide, and to create monochloramine by reaction of chlorine and ammonia, passing the raw water through further treatment steps wherein solids are removed and where residual chlorine dioxide is consumed prior to distribution, and collecting a potable finished water containing residual monochloramine to provide residual disinfection in the finished water.

In sixth aspect the present invention is a method for treating contaminated raw water by introducing a mixture of chlorine dioxide and monochloramine into the raw water, as it proceeds through subsequent processing steps passing the water from the first step through further processes to effect solids removal, and disinfecting the water after solids removal to cause pre-oxidation by the chlorine dioxide and introduce monochloramine into water.

In a seventh aspect the present invention is a method of treating water using streams of chlorine dioxide, chlorine and ammonia by introducing chlorine dioxide into raw water by injection into a raw water main, subjecting the raw water containing chlorine dioxide to solids removal processes, introducing additional chlorine dioxide into the water as it is withdrawn from the solids removal process and conducted to finished water storage and introducing chlorine and ammonia into water withdrawn from storage for distribution to users to provide monochloramine in the water by reaction of chlorine and ammonia.

In an eighth aspect the present invention is a method for treating water processed in a drinking water treatment plant through various process steps including solids removal by introducing a mixture of chlorine dioxide and chloramine into the water after the solids removal step.

In a ninth aspect the present invention is a method for treating water by providing a stream containing gaseous chlorine and chlorine dioxide, passing a

portion of the gaseous chlorine and chlorine dioxide stream through a porous bed of sodium chlorite to yield a first stream of chlorine dioxide, separating the remaining portion of the mixed chlorine/chlorine dioxide gas stream into two streams, the first of which contains chlorine dioxide that is substantially chlorine free, and the second stream contains chlorine with a lower level of chlorine dioxide than in the original stream, injecting the stream of chlorine into the water being treated at a point in the process after removal of sufficient organic materials so that the level of chlorinated organics created is at or below an acceptable level, and combining the first stream of chlorine dioxide and the stream of chlorine dioxide substantially free of chlorine into a mixed chlorine dioxide stream and using the mixed chlorine dioxide stream to oxidize contaminants and disinfect the water at a point in the process before sufficient organics have been removed to allow treatment with a stream containing substantial amounts of chlorine.

In a tenth aspect the present invention is a method for treating water using a stream containing gaseous chlorine and chlorine dioxide by passing at least a portion of the stream containing gaseous chlorine and chlorine dioxide through a porous bed of sodium chlorite to yield a stream of chlorine dioxide, separating the remaining portion of chlorine from the chlorine dioxide to yield a stream of chlorine and a stream of chlorine dioxide containing negligible amounts of chlorine, combining the stream of chlorine dioxide the said stream of chlorine dioxide containing negligible amounts of chlorine into a mixed chlorine dioxide stream and using the mixed chlorine dioxide stream to pre-oxidize a stream of raw water prior to further processing, such as clarification being one of a combination of, or all of the steps of coagulation, flocculation and sedimentation, filtration dissolved air flotation, and membrane filtration, and using the chlorine to disinfect the water after further processing such as clarification being one of a combination of or all of the steps of coagulation, flocculation and sedimentation, filtration, dissolved air flotation, and membrane filtration prior to storage for distribution.

In an eleventh aspect the present invention is a method for treating water by providing a stream containing gaseous chlorine and chlorine dioxide, passing the mixed chlorine/chlorine dioxide stream through a porous bed of sodium chlorite to produce a stream of substantially pure chlorine dioxide, injecting chlorine into the water being treated at a point in the process after removal of sufficient

organic material such that the level of chlorinated organics created is at or below an acceptable level, and using the chlorine dioxide stream to oxidize contaminants and disinfect drinking water at a point in the process before sufficient organics have been removed to allow treatment for the stream containing substantial amounts of chlorine.

Claims 4-11 are drawn to a method for treating water as it proceeds from a source to a storage or a distribution facility.

Claims 13-14 are drawn to a method for treating water.

Claims 15-17 are drawn to a method for treating water using a stream containing chlorine and chlorine dioxide.

Claims 18-21 are drawn to a method for treating and disinfecting raw or partially treated water.

Claims 22-25 are drawn to a method of treating contaminated raw water.

Claims 26-27 are drawn to a method of treating water using streams of chlorine dioxide, chlorine and ammonia.

Claims 28-31 are drawn to a method for treating water processed in a drinking water treatment plant.

Claims 32-33 are drawn to a method for treating water.

Claims 34-35 are drawn to a method for treating water using a stream containing gaseous chlorine and chlorine dioxide.

Claims 37 and 38 are drawn to a method for treating water.

Appellants respectfully contend that the present claims are patentable over Griese et al. U.S. Patent 5,314,629; Hurst U.S. Patent 4,693,832; Harp et al. U.S. Patent 6,315,950; Glew et al. U.S. Patent 4,137,296 or Rosenblatt et al. U.S. Patent 5,110,580 as well as any art of record in the application. None of the art available at the time the Appellants made their invention would have led a worker

skilled in the art to solve the problems addressed by Appellants. Even, assuming that the references were combined, the claimed invention is patentably distinct from those references combined in the absence of further modification of the combination, which modification can only be accomplished by using Appellants own teaching to not only select but to interpret the references. Lastly, Appellants contend each of the cited references individually teach away from the modifications necessary to the references either individually or collectively to achieve Appellants' invention.

## **VI. ISSUES**

(1) Was claim 12 properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Griese et al. in view of Hurst.

(2) Were claims 22- 28 and 30 properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Griese et al. in view of Harp et al.

(3) Were claims 4-11, 18-21, 29 and 31 properly rejected under 35 U.S.C. § 103(a) as unpatentable over Griese et al. in view of Hurst, and further in view of Harp et al.

(4) Were claims 13 and 15 properly rejected under 35 U.S.C. § 103(a) as being unpatentable in view of Griese et al. in view of Glew et al.

(5) Were claims 14, 16 and 17 properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Griese et al. in view of Glew et al. and further in view of Harp et al.

(6) Were claims 32, 34 and 37 properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Griese et al. in view of Glew et al. and further in view of Rosenblatt et al.

(7) Were claims 33, 35, 36 and 38 properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Griese et al. in view of Glew et al. and Rosenblatt et al. and further in view of Harp et al.

**VII. GROUPING OF CLAIMS**

Claims 4-11 stand as one embodiment of the invention.

Claim 12 stand as a second embodiment of the invention.

Claims 13-14 stand as a third embodiment of the invention.

Claims 15-17 stand as a fourth embodiment of the invention.

Claims 18-21 stand as a fifth embodiment of the invention.

Claims 22-24 stand as a sixth embodiment of the invention.

Claims 26-27 stand as a the seventh embodiment of the invention.

Claims 28-31 stand as an eighth embodiment of the invention.

Claims 32-33 stand as a ninth embodiment of the invention.

Claims 34-36 stand as a tenth embodiment of the invention.

Claims 37-38 stand as an eleventh embodiment of the invention.

**VIII. ARGUMENT**

For the reasons set forth below Appellants respectfully submit that the Final Rejection was improperly made and should be withdrawn.

Appellants invention comprises two separate and distinct aspects of treating water that are neither taught nor suggested in the prior art cited by the Examiner, namely:

"1) The use using a mixture of chlorine dioxide and chlorine to treat water, and

2) The use of a mixture of chlorine dioxide and monochloramine to treat water."

The two aspects of the invention are intimately related in that a novel chlorine dioxide-monochloramine mixture may be formed by adding ammonia to the chlorine dioxide-chlorine mixture. For the reasons that will follow Appellants respectfully submit that the use of such mixtures are neither taught nor suggested in the prior art.

Generally, the chlorine-chlorine dioxide mixture is best applied to water with relatively low to moderate THMFP (trihalomethanes formation potential)--for example, in low demand raw water and finished water. The chlorine dioxide-chloramine mixture is best applied to water with relatively high THMFP.

The application of the chlorine-chlorine dioxide mixture may achieve greater disinfection (a higher total CxT, i.e. concentration C, multiplied by contact time T) than the application of either chlorine or chlorine dioxide alone, while staying within the DBP (disinfection by-product) limits for trihalomethane (THM), haloacetic acids (HAA) and chlorite ion. This is because each of the oxidants have different, individually regulated DBPs, but their CxT "credits" may be additive. Further, the phenomenon of "chlorite ion recycling" affords maintenance of a higher chlorine dioxide residual, without increasing the applied chlorine dioxide dose. This facilitates a higher chlorine dioxide CxT credit without an increase in residual chlorite ion, a regulated DBP. The application of the chlorine dioxide-monochloramine mixture can achieve high-level, rapid oxidation/disinfection while simultaneously achieving persistent, long-lasting, low level oxidation and disinfection.

The sequential application of these mixtures to water treatment-e.g., by starting with the chlorine-chlorine dioxide mixture, and then converting it into the chlorine dioxide-chloramine (by the addition of ammonia) may under some circumstances be especially advantageous.

The ability to utilize a mixture of chlorine and chlorine dioxide adds the economic advantage of being able to use less expensive generation techniques-e.g., HCl and sodium chlorate-that previously had been rejected because they generate mixtures of chlorine and chlorine dioxide.

The application of various oxidants, including chlorine dioxide, chlorine, and monochloramine, is well known in the art of water treatment. But

oxychlorine chemistry is complex. One can't simply assume that oxychlorine compounds, in mixture, will behave as they do individually. They usually don't. Related oxychlorine species that can play important roles in water treatment applications include chlorine dioxide ( $\text{ClO}_2$ ), monochloramine ( $\text{NH}_2\text{Cl}$ ), dichloramine ( $\text{NHCl}_2$ ), nitrogen trichloride ( $\text{NCl}_3$ ), chlorine ( $\text{Cl}_2$ ), chlorite ion ( $\text{ClO}_2^-$ ), chlorate ion ( $\text{ClO}_3^-$ ), perchlorate ion ( $\text{ClO}_4^-$ ), chlorous acid ( $\text{HClO}_2$ ), hypochlorite ion ( $\text{OCl}^-$ ), and hypochlorous acid ( $\text{HOCl}$ ). On mixing (in water), these species can react with each other and even with the water itself. The extent and nature of the reaction(s) are determined by, among other things, the absolute and relative concentrations of the reactants, pH, temperature, and the presence of other chemicals.

It should be noted that ozone ( $\text{O}_3$ ) is another oxidant used in water treatment. Certain features of ozone chemistry may help underscore the point that just because an oxidant can be used individually to treat water, it doesn't necessarily follow that it can also be used in mixture with other oxidants.

Each oxidant used in water treatment has its own, unique set of associated disinfection by-products (DBPs), many of which are regulated. Chlorine forms THMs and HAAs in reaction with organics. Ozone forms aldehydes, carboxylic acids and bromate ion (from bromide ion). Chlorine dioxide use results in chlorite ion and chlorate ion. Since ~50-70% of applied dose of chlorine dioxide winds up as chlorite ion, the MCL (regulated limit) of 1ppm for chlorite ion effectively limits the applied dose of chlorine dioxide to a maximum 1.4ppm.

Each oxidant used in water treatment also has a unique set of capabilities for killing target organisms. The relative hierarchy may change, depending on the organism being targeted. The ability to kill microbes is inversely proportional to its "required CxT" value. That is, the lower the required CxT, the more effective the disinfectant. The CxT for ozone (the strongest of the chemical disinfectants) vis-à-vis *Cryptosporidium parvum* (a waterborne pathogenic parasite) is lower than that for chlorine dioxide, which is lower than that for chlorine, which is lower than that for chloramines (the weakest of the chemical disinfectants). Yet, chlorine and chlorine dioxide are comparably effective against viruses. The task of achieving necessary levels of disinfection/oxidation, while complying with DBP regulations, is a major challenge to water treaters. Part of the value of the present

invention is that it helps water treaters to balance the conflicting requirements (DBP limits vs disinfection/oxidation requirements) and better meet that challenge.

High oxidant demand and THM "formation potential" (THMFP) are usually, but not always, coincident. For example, if water has a low organics content but very high metals content (iron, manganese), the oxidant demand would be high, but the THMFP would be low. Generally, the oxidant demand and THMFP decrease as the water progresses through treatment steps. This information may be useful in understanding why the two mixtures of the subject invention may more or less advantageously applied at different treatment points, and may sometimes be advantageously converted from the first to the second, in the course of the water treatment process.

A. Claim 12 is not obvious over Griese et al. in view of Hurst

It is well known that chlorine-chlorine dioxide, ozone and monochloramine are applied sequentially in various combinations in the treatment of drinking water. However, the art teaches against any of these oxidants, and especially against chlorine dioxide, being mixed with other oxidants. In the case of chlorine dioxide, the art teaches against both generation of a mixture and also against application of a mixture, to wit:

From George Clifford White's Handbook of Chlorination and Alternative Disinfectants, 4<sup>th</sup> Ed., (1998) the following information is relevant to understanding the prior art that was available when Appellants made their invention.

Chapter 12. Chlorine Dioxide (pp 1134) there is a specific admonition against mixing chlorine dioxide with other oxidants:

"never mix chlorine dioxide with other oxidants (e.g., ozone)"

Chapter 12. Chlorine Dioxide (pp 1159-1160) argues for a standard for chlorine dioxide "Purity", limiting the aggregate amount of free chlorine, chlorite ion and chlorate ion in chlorine dioxide (being used for drinking water treatment). The author proposes a "procurement specification" based on said Purity standard, limiting the total aggregate amount of free chlorine, chlorite ion and chlorate ion in chlorine

dioxide to a maximum of 1% by weight. In the most extreme case, this would permit a maximum chlorine content of 1% by weight.

Chapter 12. Chlorine Dioxide (pp 1169-1170) reviews chlorine dioxide production methods. Notwithstanding potential economic advantages, it rejects certain sodium chlorate based methods owing to chlorine content of the chlorine dioxide product:

"The prospect of being able to use a much-lower-cost feedstock to produce chlorine dioxide (i.e., sodium chlorate vs. sodium chlorite) is enticing...Attempts... have combined concentrated acid such as hydrochloric with sodium chlorate...". The chemistry is wholly unsatisfactory...as it produces an effluent with severely depressed pH that tends to contain high chlorine-impurity levels."

For example, in the USEPA Guidance Manual (1999):

Chapter 4. Chlorine Dioxide §4.4.2 Chlorine Dioxide Purity, teaches against the presence of chlorine in the generated chlorine dioxide:

"Chlorine dioxide generators are operated to obtain the maximum production (yield) of chlorine dioxide, while minimizing free chlorine or other residual oxidant formation... In addition, the measurable excess chlorine should be less than 2 percent by weight in the generator effluent."

Chapter 9. Combined Disinfectants. §9.1.6 Chlorine/Chlorine to Chlorine Dioxide/Chlorine, teaches against the presence of excess chlorine in the chlorine dioxide feed stream:

"Use of chlorine dioxide as a pre-oxidant to replace chlorine may allow moving the point of chlorination downstream in the process train for application to water with lower NOM (natural organic matter) concentrations. The reduced precursor concentration and the reduced chlorine dose should result in a reduction of chlorinated DBPs. However, if excess chlorine is present in the chlorine dioxide feed stream, it would react with NOM prior to removal in sedimentation and filtration if pre-oxidation is practiced"

Chapter 9. Combined Disinfectants, §9.2 Pathogen Inactivation with Interactive Disinfectants, discusses both sequential application of oxidants, as well as application of "combinations". EPA's discussion of combinations (mixtures) was limited to: (a) free chlorine and organic N-halamine, (b) free chlorine and sodium bromide, and (c) chloramine and cupric chloride. Chlorine-chlorine dioxide, ozone and monochloramines are never discussed in mixture with each other, but only vis-à-vis sequential application:

"...Research on interactive disinfectants for primary pathogen inactivation is under way for several combinations of disinfectants:

Chlorine followed by chloramine;  
Chlorine dioxide followed by chlorine;  
Chlorine dioxide followed by chlorine dioxide;  
Chlorine dioxide followed by chloramine;  
Ozone followed by chlorine;  
Ozone followed by chlorine dioxide; and  
Ozone followed by chloramine."

Also:

Chapter 9. Combined Disinfectants. §9.1.3 Chlorine/Chlorine to Chlorine/Chloramine, teaches against the presence of excess free chlorine in mixture with monochloramines: Excess free chlorine in the presence of a mixture of monochloramine and chlorine dioxide will also produce dichloramine and trichloramine (a/k/a nitrogen trichloride). This highlights the complexity and sensitivity of monochloramine-formation chemistry.)

"...the ammonia/chlorine mixing conditions should be optimized to quickly remove free chlorine from the system

Chapter 9. Combined Disinfectants. §9.1.4 Chlorine/Chlorine to Ozone/Chlorine, teaches against the mixing of ozone and chlorine. (This highlights the fact that, just because an oxidant can be used individually, it doesn't necessarily follow that it can also be used in mixture with other oxidants.)

"...ozone should be completely decomposed or chemically quenched prior to chlorine addition. If ozone is present when chlorine is added, the ozone will react with the chlorine and NOM (define NOM) present to form chlorinated DPBs..."

For example, from [www.clo2.com](http://www.clo2.com), the website of Sterling Pulp Chemicals, a leading worldwide supplier of chlorine dioxide technology, and one of the world's largest producers of sodium chlorate and sodium chlorite, one finds a teaching against combining ammonia with chlorine dioxide (<http://www.clo2.com/factsheet/safety.html>):

**"Reactive Chemical Hazards:** Chlorine dioxide is incompatible with ammonia..."

In view of the foregoing it is respectfully submitted that the Examiner has used Appellants own teaching to not only select but to interpret the prior art, which is clearly contrary to existing Patent Law.

Neither Griesse et al. nor Hurst alone or in combination teach the use of a mixture of chlorine and chlorine dioxide in a primary water treatment process, wherein the mixture either as a gas or in solution is injected into the water where the point of injection is after THM precursors are removed from the water such that the level of chlorinated bi-products created is within acceptable limits.

Therefore, in view of the foregoing it is respectfully submitted that the final rejection of claim 12 under 35 U.S.C. § 103(a) is not well taken and should be reversed.

B. Claims 22-28 and 30 are not Obvious over Griesse et al. in view of Harp et al.

For the reasons set forth above it is respectfully submitted that Griesse et al. neither teaches nor suggests using a mixture of chlorine and chlorine dioxide to treat the water. Furthermore, neither Griesse et al. alone or Harp et al. alone or in combination teach or suggest the use of injecting a mixture of chlorine dioxide and monochloramine into raw water to cause pre-oxidation by chlorine dioxide and introduction of monochloramine into the water as it proceeds through subsequent processing steps while treating the water after solid removal with a mixture of

chlorine dioxide and chlorine or a mixture of chlorine dioxide chlorine and ammonia for final disinfection.

Here again, the Examiner is using Appellants' own teaching to not only select but to interpret the prior art, clearly contrary to existing Patent Law. For the reasons pointed out above by the art none of the references can be interpreted individually or in combination to teach or suggest that mixtures of chlorine and chlorine dioxide should be used in treating water. This is further reinforced by the fact that in view of the more current art, as reflected by the teaching in the Handbook of Chlorination and Alternative Disinfection, the USEPA Guidance Manual and the Sterling Pulp Chemicals Web Site, the processes of Griesse et al. would not be modified by the teaching of Harp et al. since the current technology is to do other than suggested by Appellants' invention. In point of fact, the new art teaching of the cited prior art can be interpreted to teach only these processes that are directly opposite to those of the present invention. Only when using Appellants' teaching is used to interpret the prior art can the Rejection seem viable. Again this clearly contrary to existing Patent Law.

It cannot be too strongly argued that the processes of the present invention are not merely process optimization, and the use of pretreated side streams is a novel addition to the otherwise novel and unobvious basic process.

Therefore, it is respectfully submitted that the final rejection of claims 22-28 and 30 under 35 U.S.C. § 103(a) is not well taken and should be reversed.

C. Claims 4-11, 18-21, 29 and 31 are not obvious over Griesse et al. in view of Hurst et al. further in view of Harp et al.

While adding chlorine to ammonia or ammonia to chlorine to form monochloramine is known in the prior art what is not known and unobvious is that the process of the present invention begins with a chlorine-chlorine dioxide mixture resulting in forming chloramines by reacting the chlorine with ammonia in the presence of chlorine dioxide and utilizing a mixture of chloramines and chlorine dioxide, which is clearly neither taught nor suggested by the prior art. Here again, the Examiner is using Appellants' own teaching to not only select but to interpret the references, which is clearly contrary to existing Patent Law.

Since the basic process of the invention is neither taught nor suggested by the prior art, the sub-steps of the present invention cannot be considered obvious over the prior art.

Again, Appellants refer to the discussion above concerning the prohibition in the art of using chlorine-chlorine dioxide mixtures in water treatment and the fact that they have utilized chlorine-chlorine dioxide mixtures with and without ammonia to provide effective water treatment processes.

Therefore, it is respectfully submitted that the final rejection of claims 4-11, 18-21, 29 and 31 under 35 U.S.C. § 103(a) is not well taken and should be reversed.

D. Claims 13 and 15 are not obvious over Griese et al. in view of Glew et al.

For the reasons set forth above it is respectfully submitted that the teaching of Griese et al. neither teaches nor suggests the processes of the present invention, which have at their core using mixtures of chlorine and chlorine dioxide or chlorine dioxide and chloramines. While the generation of mixtures of chlorine and chlorine dioxide and the separation thereafter of the components are well known in industry, especially in the pulp and paper industry, no one has taught or suggested using a chlorine-chlorine dioxide mixture for water treatment. Therefore, there is no teaching in the water treatment processes of the prior art of separating chlorine-chlorine dioxide mixtures into its constituent chlorine dioxide and chlorine components.

Here again, the claims set forth the process by starting with the mixture of chlorine-chlorine dioxide and separating the stream so that the chlorine and chlorine dioxide can be used in various parts of the overall water treatment process. Here again since the use of a chlorine-chlorine dioxide mixture in water treatment is strongly taught against by the prior art, one would not start with such mixtures which can then be separated into components of a water treatment process.

In view of the foregoing it is respectfully submitted that the final rejection of claims 13 and 15 under 35 U.S.C. § 103(a) is not well taken and should be reversed.

- E. Claims 14, 16 and 17 are not obvious over Griese et al. in view of Glew et al. further in view of Harp et al.

The Examiner has rejected claims 14, 16 and 17 under 35 U.S.C. § 103(a) over Griese et al. in view of Glew et al. and further in view of Harp et al. Here again, there is no argument with the fact that addition of chlorine to ammonia or ammonia to chlorine is a method by which chloramines can be produced. However, what is not taught nor suggested by the prior art and what is new is the processes of the present invention that start with a chlorine dioxide-chlorine mixture and then and form chloramines by reacting chlorine with ammonia in the presence of chlorine dioxide and utilizing mixtures of chloramines and chlorine dioxide in the claimed processes to treat the water. For the reasons set forth above it is respectfully submitted that the prior art would lead one to concluding that the use of chlorine-chlorine dioxide mixtures are undesirable in providing effective water treatment. Appellants have shown that the use of a chlorine-chlorine dioxide mixture which can be separated into various fractions and used in various parts of the water treatment process with or without the addition of ammonia to result in a mixture of chlorine dioxide and chloramine is neither taught nor suggested by the prior art. Here again the Examiner is using Appellant's teaching to not only select but to interpret the prior art, which is clearly contrary to existing Patent Law.

Therefore, it is respectfully submitted that the final rejection of claims 14, 16 and 17 under 35 U.S.C. § 103(a) is not well taken and should be reversed.

- F. Claims 32, 34 and 37 are not obvious over Griese et al. in view of Glew et al. further in view of Rosenblatt et al.

Contrary to the interpretation by the Examiner, Rosenblatt et al. teaches separation of a chlorine dioxide effluent stream from a reactor stream that may contain residual chlorine gas. The product of the reactor is passed through a scrubber to remove any residual chlorine prior to the application of the chlorine dioxide for the intended purpose. The use of the scrubber is to remove trace

amounts of chlorine gas contaminant from a system designed to produce substantially pure chlorine dioxide. Contrast this with the present invention which intentionally starts with a chlorine-chlorine dioxide mixture, which is then processed in various ways to provide components for treatment of water to make it potable. The chlorine is not scrubbed from the mixture but is an integral and useful part of the mixture used in Appellant's process.

Here again, Appellants refer to the above discussion concerning the fact that the accepted prior art suggests that mixtures of chlorine and chlorine dioxide should not be used in water treatment. Once again if Appellants' teaching is divorced from the prior art, it neither teaches nor suggests that the use of chlorine-chlorine dioxide mixtures can be the starting point for effective water treatment.

In view of the foregoing it is respectfully submitted that the final rejection of claims 32, 34 and 37 under 35 U.S.C. § 103(a) is not well taken and should be reversed.

G. Claims 33, 35, 36 and 38 are not obvious over Griese et al. in view of Glew et al. and Rosenblatt et al. further in view of Harp et al.

For the reasons set forth above, it is respectfully submitted that the references either alone or in combination neither teach nor suggest the present invention which resides in starting with a chlorine dioxide-chlorine mixture, forming chloramines by reacting chlorine with the ammonia in the presence of chlorine dioxide, and utilizing a mixture of chloramines and chlorine dioxide to provide an effective water treatment process.

Here again, for the reasons set forth above, the prior art neither teaches nor suggests starting with a chlorine dioxide-chlorine mixture and in point of fact teaches away from using such a mixture as a starting point. Once the Appellants teaching is divorced from the prior art there is neither a teaching nor a suggestion of Appellants' process from the art cited by the Examiner.

In view of the foregoing it is respectfully submitted that the rejection of claims 33, 35, 36 and 38 under 35 U.S.C. § 103(a) is not well taken and should be withdrawn.

The PTO has the burden under Section 103 to establish a *prima facie* case of obviousness. *In re Fine*, 5 USPQ2d 1596, 1598 (Fed. Cir 1988). "It can satisfy this burden only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references." *Id.*; see *In re Levengood*, 28 USPQ2d 1300, 1301 (PTO Bd. Pat. App. & Inter. 1993) ("In order to establish a *prima facie* case of obviousness, it is necessary for the examiner to present evidence . . . that one having ordinary skill in the art would have been led to combine the relevant teachings of the applied references in the proposed manner to arrive at the claimed invention.") (emphasis in original); see also MPEP § 706.02. This has not been done. The applied references have been improperly combined, using hindsight reconstruction, without evidence to support the combination.

"Our case law makes clear that the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is a rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references." *In re Dembiczak*, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999) (reversing PTO's obviousness and obviousness-type double patenting rejections of an application directed to a pumpkin-type trash bag) (citing the three sources for a possible motivation or suggestion to combine from *In re Rouffet*, 47 USPQ2d 1453 (Fed. Cir. 1998), and stating, "The range of sources available, however, does not diminish the requirement for actual evidence. That is, the showing must be clear and particular. . . . Broad conclusory statements regarding the teaching of multiple references, standing alone, are not 'evidence.' . . . Nowhere does the Board particularly identify any suggestion, teaching, or motivation to combine the . . . references.").

A specific fallacy in the reasoning of the Examiner lies in ignoring the precise teachings of each of the references. In addition to the actual disclosures outlined above, none of the reference are concerned with the focus of the present invention, which (as stated in the current specification) was developed for the

purpose of providing a method for treating water using chlorine, chlorine dioxide and ammonia in various combinations and in gaseous or dissolved form. Moreover, appellants respectfully submit that the Examiner has used their teaching to piece together parts of the prior art to conclude that it would have been obvious to reach that which is presently claimed. Under comparable circumstances, the CCPA stated:

[A] person having the references before him who was not cognizant of appellant's disclosure would not be informed that the problems solved by the appellant ever existed. Therefore, can it be said that these references which never recognized appellant's problem would have suggested its solution? We think not, and therefore feel that the references were improperly combined since there is no suggestion in either of the references that they can be combined to produce appellant's result.

*In re Shaffer*, 108 USPQ 326, 329 (CCPA 1956).

When an obviousness determination depends on a selective combination of prior art references, there must be some reason for the combination other than hindsight gleaned from the invention itself. The prior art under consideration must contain a teaching or motivation or incentive or suggestion to do so. The governing legal principle was stated precisely in *Northern Telecom, Inc. v. Datapoint Corp.*, 15 USPQ 1321, 1323 (Fed. Cir. 1990):

It is insufficient that the prior art disclosed the components of the [claimed] device, either separately or used in other combinations; there must be some teaching, suggestion, or incentive to make the combination made by the inventor. *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1143, 227 USPQ 543, 551 (Fed. Cir. 1988) (insufficient to select from the prior art the separate components of the inventor's combination, using the blueprint supplied by the

inventor); *Rosemount, Inc. v. Beckman Instruments, Inc.*, 727 F.2d 1540, 1546, 221 USPQ 1, 7 (Fed. Cir. 1984) ("As this court has held, 'a combination may be patentable whether it be composed of elements all new, partly new or all old'" (citations omitted); *W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1551, 220 USPQ 303, 312 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984) (individual references can not be "employed as a mosaic to recreate a facsimile of the claimed invention.")[.]

*See also In re Levengood*, 28 USPQ2d at 1301 ("an examiner cannot establish obviousness by locating references which describe various aspects of a patent appellant's invention without also providing evidence of the motivating force which would impel one skilled in the art to do what the patent appellant has done.").

To the extent the Examiner has relied on motivating forces, these too are misplaced for the reasons set out above. Here again, appellants respectfully submit that only through hindsight gleaned from the present invention could a conclusion that the art teaches or suggests a motivation to combine the references have been reached. This is especially true in the view of the fact that the Griesse et al. teaching has an effective date of November 6, 1992, the Hurst teaching has an effective date of November 27, 1985, the Harp et al. teaching has an effective date of September 4, 1998, the Rosenblatt et al. teaching has an effective date of September 14, 1989, and the Glew et al. teaching has an effective date of November 2, 1976.

Moreover, appellants submit that but for his teaching of their invention in the present patent application, no one skilled in the art would have read the references to come up with processes that effectively treat water.

Once again Appellants submit that the Examiner has fallen into the trap of using his teaching to select, and interpret the references. This is clearly contrary to existing Patent Law. *W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 721 F.2d

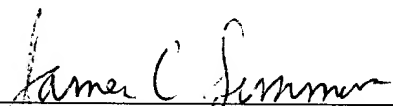
1540, 1551, 220 USPQ 303, 312 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984) (individual references can not be "employed as a mosaic to recreate a facsimile of the claimed invention."). For the reasons provided above, appellant submits that claims 4, 5, 8, 9 and 12-13 are improperly rejected.

## IX. CONCLUSION

In view of the foregoing argument, appellant submits that the subject application is in condition for allowance. Appellants respectfully request that the Honorable Board reverse the final rejection of the pending claims in the application identified above.

In accordance with 37 C.F.R. § 1.192(a), this Appeal Brief is submitted in triplicate.

Respectfully submitted,

  
\_\_\_\_\_  
James C. Simmons, Reg. No. 24,842  
Attorney for Applicant

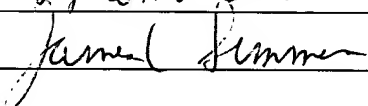
JCS/mc

Dated: September 15, 2003

P.O. Box 980  
Valley Forge, PA 19482-0980  
(610) 407-0700

The Commissioner for Patents is hereby authorized to charge payment to Deposit Account No. **18-0350** of any fees associated with this communication.

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Mail Stop Appeal Brief-Patents, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on:

15 September 2003  
  
\_\_\_\_\_

**APPENDIX**

4. A method for treating water as it proceeds from a source to a storage or distribution facility comprising the steps of:

injecting a mixture of chlorine and chlorine dioxide into said water at a location between said source and said storage or distribution facility; and

injecting ammonia into said water at, one of, a point upstream or downstream of said location where said chlorine and chlorine dioxide are injected into said water, said ammonia being injected in an amount to substantially react with said chlorine, whereby said water in said storage or distribution facility contains chlorine dioxide, monochloramine and a negligible amount of chlorine.

5. A process according to claim 4 including the step of establishing the chlorine to ammonia ratio at or below 5:1 by weight.

6. A process according to claim 4 including the step of injecting the ammonia downstream of the chlorine/chlorine dioxide injection point, but sufficiently close to the chlorine/chlorine dioxide injection point so that substantially all of the chlorine is converted to monochloramine before chlorinated organics can be formed at levels that are above acceptable limits.

7. A process according to claim 4 wherein the water is a contaminated raw water and the treatment process includes the step of applying the ammonia/chlorine/chlorine dioxide stream to the raw water before other treatment steps.

8. A process according to claim 4 including the steps of injecting the chlorine dioxide early enough in the process so that  $\text{ClO}_2$  is at an acceptable level for entry into the water distribution system.

9. A process according to claim 4 including the step of creating enough monochloramine to be carried through all treatment steps following its creation to provide all or part of the necessary disinfection in a distribution system.

10. A process according to claim 7 including the step of applying the ammonia/chlorine/chlorine dioxide stream in a raw water main near the intake of the main wherein the chlorine dioxide reacts with contaminants as the raw water flows through the raw water main.

11. A process according to claim 4 including the step of using the ammonia/chlorine/chlorine dioxide stream to one of, oxidize contaminants, or disinfect drinking water with production of chlorinated hydrocarbons kept below acceptable levels.

12. A method for treating water wherein a stream containing chlorine and chlorine dioxide is used to treat drinking water wherein the mixed chlorine and chlorine/chlorine dioxide stream (either as gas or in solution) is injected into the water being treated, and where the point of injection is after THM precursor are removed from the water such that the level of chlorinated organics created is less than the desired limit.

13. A method for treating water comprising the steps of:

a) providing a stream containing gaseous chlorine and chlorine dioxide

b) separating the mixed chlorine/chlorine dioxide stream into two streams, the first of which contains chlorine dioxide that is substantially chlorine-free, and the second stream contains chlorine with a lower level of chlorine dioxide than in the original stream;

c) injecting the stream of chlorine into said water being treated at point in the process after removal of sufficient organic material such that the level of chlorinated organics created is at or below an acceptable level; and

d) using the chlorine dioxide stream to oxidize contaminants and disinfect drinking water at a point in the process before sufficient organics have been removed to allow treatment with a stream containing substantial amounts of chlorine.

14. A process according to claim 13 including the step of injecting ammonia into said water containing chlorine entering a distribution system for treated water to convert said chlorine to monochloramine.

15. A method for treating water using a stream containing chlorine and chlorine dioxide comprising the steps of:

separating the chlorine from the chlorine dioxide to yield a stream of chlorine and a stream of chlorine dioxide;

using said chlorine dioxide to pre-oxidize a stream of raw water prior clarification;

subjecting said water after treatment with chlorine dioxide to clarification by one, a combination of, or all of the steps of coagulation, flocculation and sedimentation, filtration; dissolved air flotation, and membrane filtration; and

using said chlorine to disinfect said water after clarification and prior to storage for distribution.

16. A method according to claim 15 including the step of adding ammonia to said water as it is withdrawn from storage for distribution to create monochloramine in said water for distribution.

17. A method according to claim 16 including the step of establishing the initial chlorine to ammonia ratio at or below 5:1 by weight.

18. A method for treating and disinfecting raw or partially treated water comprising the steps of:

introducing a mixture of chlorine, chlorine dioxide and ammonia into said raw or partially treated water to provide disinfection of the water by chlorine dioxide and creation of monochloramine by reaction of chlorine and ammonia;

passing said raw water through a clarification step being, one of, a combination of, or all of coagulation, flocculation and sedimentation, filtration, dissolved air flotation and membrane filtration whereby residual chlorine dioxide is consumed prior to filtration; and

collecting a potable finished water containing any residual monochloramine to provide residual disinfection of said finished water.

19. A method according to claim 18 including the step of adding ammonia and chlorine to said potable water as it is introduced into a distribution system to create monochloramine in said water.

20. A method according to claim 18 including the step of withdrawing a side stream of raw or partially treated water, introducing ammonia, chlorine and chlorine dioxide into said side stream which is then recycled into a main stream of said water.

21. A method according to claim 19 including the step of establishing the initial chlorine to ammonia ratio at or below 5:1 by weight.

22. A method of treating contaminated raw water comprising the steps of:

a) introducing chlorine dioxide and monochloramine into said raw water to cause pre-oxidation by said chlorine dioxide and introduce monochloramine into said water as it proceeds through subsequent processing steps;

b) passing said water from step a) through clarification being, one, a combination of, or all of the steps of coagulation, flocculation and sedimentation, filtration dissolved air flotation and membrane filtration to effect solids removal; and

c) treating said water after solids removal and prior to storage with one of chlorine dioxide, a mixture of chlorine dioxide and chlorine, or a mixture of chlorine dioxide, chlorine and ammonia for disinfection.

23. A method according to claim 22 including the step of introducing said ammonia at each location at a ratio of chlorine to ammonia of 5 to 1 or less by weight.

24. A method according to claim 22 including the step of introducing ammonia into water as it is withdrawn from storage when said withdraw water contains residual chlorine.

25. A method according to claim 24 including the step of introducing said ammonia at a ratio of chlorine to ammonia of 5 to 1 or less by weight.

26. A method of treating water using streams of chlorine dioxide, chlorine and ammonia comprising the steps of:

- a) introducing chlorine dioxide into raw water in a raw water main;
- b) subjecting said raw water containing chlorine dioxide to clarification being one, a combination of, or all of the steps of coagulation, flocculation and sedimentation, filtration, dissolved air flotation and membrane filtration;
- c) introducing additional chlorine dioxide into said water as it is withdrawn from step b) and conducted to finished water storage; and
- d) introducing chlorine and ammonia into water entering finished water storage or as it is withdrawn from storage for distribution to users to provide monochloramine in said water by reaction of chlorine and ammonia.

27. A method according to claim 26 including the step of introducing said ammonia into said water in step d) at a ratio of chlorine to ammonia of 5 to 1 or less by weight.

28. A method for treating water processed in a drinking water treatment plant through various process steps including solids removal by introducing a mixture of chlorine dioxide and chloramine into said water after said solids removal step.

29. A method according to claim 28 including the step of preparing said mixture of chlorine dioxide and chloramine by adding ammonia to a mixture of chlorine and chlorine dioxide at a ratio of chlorine to ammonia of 5:1 or less by weight.

30. A method according to claim 28 including the step of withdrawing a side stream of water after said solids removal step, introducing chlorine dioxide and monochloramine into said side stream and injecting said side

stream of water with chlorine dioxide and monochloramine into said water downstream of where said side stream is withdrawn.

31. A method according to claim 27 including the step of withdrawing a side stream of water after said solids removal step, introducing chlorine dioxide, chlorine and ammonia into said side stream said chlorine to ammonia ratio being 5 to 1 or less in said side stream and introducing said side stream into said water downstream of where said side stream is withdrawn.

32. A method for treating water comprising the steps of:

a) providing a stream containing gaseous chlorine and chlorine dioxide

b) passing a portion of the gaseous chlorine and chlorine dioxide stream through a porous bed of sodium chlorite to yield a first stream of chlorine dioxide;

c) separating the remaining portion of the mixed chlorine/chlorine dioxide stream into two streams, the first of which contains chlorine dioxide that is substantially chlorine-free, and the second stream contains chlorine with a lower level of chlorine dioxide than in the original stream;

d) injecting the stream of chlorine into said water being treated at point in the process after removal of sufficient organic material such that the level of chlorinated organics created is at or below an acceptable level; and

e) combining the first stream of chlorine dioxide and the stream of chlorine dioxide substantially free of chlorine into a mixed chlorine dioxide stream and using the mixed chlorine dioxide stream to oxidize contaminants and disinfect the water at a point in the process before sufficient organics have been removed to allow treatment with a stream containing substantial amounts of chlorine.

33. A process according to claim 32 including the step of injecting ammonia into said water containing chlorine entering a distribution for treated water system to convert said chlorine to monochloramine.

34. A method for treating water using a stream containing chlorine and chlorine dioxide comprising the steps of:

passing a portion of the stream containing chlorine and chlorine dioxide through a porous bed of sodium chlorite to yield a stream of chlorine dioxide;

separating the remaining portion of the chlorine from the chlorine dioxide to yield a stream of chlorine and a stream of chlorine dioxide containing negligible amounts of chlorine;

combining said stream of chlorine dioxide and said stream of chlorine dioxide containing negligible amounts of chlorine into a mixed chlorine dioxide stream and using said mixed chlorine dioxide stream to pre-oxidize a stream of raw water prior clarification using, one of, a combination of, or all of the steps of coagulation, flocculation and sedimentation, and filtration; and

using said chlorine to disinfect said water after clarification and prior to storage for distribution.

35. A method according to claim 34 including the step of adding ammonia to said water as it is withdrawn from storage for distribution to create monochloramine in said water for distribution.

36. A method according to claim 35 including the step of establishing the initial chlorine to ammonia ratio at or below 5:1 by weight.

37. A method for treating water comprising the steps of:

a) providing a stream containing gaseous chlorine and chlorine dioxide

b) passing the mixed chlorine/chlorine dioxide stream through a porous bed of sodium chlorite to produce a stream of substantially chlorine dioxide;

c) injecting chlorine into said water being treated at point in the process after removal of sufficient organic material such that the level of chlorinated organics created is at or below an acceptable level; and

d) using the chlorine dioxide stream to oxidize contaminants and disinfect drinking water at a point in the process before sufficient organics have been removed to allow treatment with a stream containing substantial amounts of chlorine.

38. A process according to claim 37 including the step of injecting ammonia into said water containing chlorine entering the distribution system to convert said chlorine to monochloramine.